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13. ABSTRACT *(Maximum 200 words)*
THIS PAPER IS INTENDED TO COVER THE SAMPLING AND QUALITY CONTROL PROCEDURES FOR THE CALGON CARBON ADSORPTION SYSTEM WHICH TREATS THE GROUND WATER AT THE NORTH BOUNDARY OF RMA.

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DETAILED SAMPLING AND QUALITY CONTROL PROCEDURES

FOR THE CALGON WATER TREATMENT FACILITY

AT

ROCKY MOUNTAIN ARSENAL

81356R61
original

IN SUPPORT OF PROGRAM

UNDER ITARMS 1.05.12

By

Process Development and Evaluation Division of

The Contamination Control Directorate

ROCKY MOUNTAIN ARSENAL
Commerce City, Colorado 80022

June 1978

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INTRODUCTION:

This paper is intended to cover the sampling and quality control procedures for the Calgon Carbon Adsorption System which treats the ground water at the north boundary of Rocky Mountain Arsenal. The samples frequency and their location are given below.

LOCATION	SAMPLE FREQUENCY (OR READING)	PHASE
Influent to filter	Up to 15/day with random grab samples	Start-up
Filter effluent	Up to 15/day with random grab samples	
Adsorber effluent	Up to 15/day with random grab samples	
Differential pressure across filters	1/hr. during 8 hr. work day	
Totalizer flow	1/hr. during 8 hr. work day	
Instant flow	Up to 15/day with random readings taken at times of grab samples	
Influent to filter	2/day and 1 random grab sample	Psuedo Steady State (Stabilization Period)

Reasons for control charts:

(1) Early warning* of DIMP breakthru.
(2) Records of plant operation.
(3) Verification of experiments leading to plant.
(4) Early warning* out of control conditions.
(5) Plant problems pinpointed thus trouble-shooting simplified.
(6) Day-to-day operation can be monitored and changes made studied.

The levels of certain materials in the ground water in the vicinity of the Calgon Plant have been closely ranged and can be used for an initial baseline. This baseline will be altered by the new information so as to maintain a realistic and current baseline. For the materials (contaminates) which have no prior

* The control chart is an excellent indicator of when the contaminate levels have exceeded standards set by the Project Manager's office.

history a baseline can be started using the first 8-10 analyses samples and updated as new analyses are reported. Both inputs of data, prior history and no prior history contaminates, will be loaded into the SIAO computer to generate control charts on the applicable chemicals and water qualities. Thus, not only will a bookkeeping of these materials be made but a monitoring of plant operations can also be made.

LOCATION	SAMPLE OR READING FREQUENCY	PHASE
Filter Effluent	2/day and 1 random grab sample/week	Stabilization Phase
Differential Pressure	1/day during 8 hr. work day	
Totalizer Flow	1/day during 8 hr. work day	
Instant Flow	2/day	
Influentto Filter	1/day and 1 random grab sample/week	
Filter Effluent	1/day and 1 random grab sample/week	Steady State Phase
Adsorber Effluent	1/day and 1 random grab sample/week	
Differential Pressure Across Filters	1 week	
Totalizer Flow	1 week	
Instant Flow	1/day and 1 random reading/week	

Chemicals similar to those being tested for will have an effect on the control charts. Thus, some of the new unknown chemicals can be detected from control chart variations. Periodic testing of samples for all constituents plus control chart monitoring should enable unknown and/or new chemical compounds to be reliably found when the chemical compounds first make their appearance.

ADDITIONAL INFORMATION:

1. Compounds tested for with prior level history and the approximate ranges of contaminate levels.

1.1. Those compounds having known prior levels will have the previous levels incorporated into the statistical baseline with the new data updating the control chart parameters. This method of updating leads to accurate and stable control chart levels.

2. Compound tested for with no prior level history (baseline).

2.1. The first ten inputs of data will be used to set the initial control chart point. The data from the samples which follow ~~which are to~~ will be used to update the control chart parameters. Again, accuracy and stability of the control chart levels will be continually improved.

CALGON PLANT OPERATIONS (QC PROGRAM)

Some notes: Use of control charts

$\bar{x}$ - Mean

$\pm 3\sigma$ - ~~Gives~~ Means only .3% of all values fall outside by random change--99.7% that fall outside ~~otherwise~~ are significant deviations and indicate process exceeding limit.

How $\bar{x}$ values shown -- baseline from history and computation of similar operations in same industrial environment.

SAMPLE GRAPH - See attached.

What should be plotted:

DIMP	DCPD (monitor only)
pH	Conductivity
TOC	Fls
Suspend Sol	Differ. press. filter

Data flow: Samples to MALD -- analysis for compounds listed.

Results to SIAO -- plot of control charts

Results to PDE -- record and control of equipment

Partial results to Calgon --- contract requirements

Special Note: Some compounds / qualities have no statistical baseline, therefore, running baseline statistics will be generated using the formulation below:

(1) Subgroup averages method:

$$\bar{\bar{x}} \pm 3\sigma_{\bar{x}} = x + \frac{3\sigma'}{\sqrt{n}}$$

$\bar{x}$ = sub group average

$\sqrt{\bar{x}}$ = std. dev. of population of average of sub group

$\sqrt{s}$ = std. dev. of population of individ. values

n = number of values in each sub group

(2) Series subgroup method (better):

$\bar{x}$ = average of subgroup

R = Range = maxi - min value of subgroup

$\bar{\bar{x}}$ = Average of all subgroups taken

$\bar{R}$ = Average range of all subgroups

Statistics Calculated:

Averages	$\bar{\bar{x}} + A_2\bar{R}$	$\bar{\bar{x}} - A_2\bar{R}$
Ranges	$D_4\,\bar{R}$	$D_3\,\bar{R}$
	Upper limit	Lower limit

A_2, D_4, D_3 From charts of Control Limit Factors (Juran (Sect. 23-9 ("Q.C. Hdbk."

SAMPLE FREQUENCY AND SIZE: Rationale

It was determined after a technical and statistical analysis that the sample frequency could be reduced to one sample per day of 2 liter size. The size of the sample was set by MALD and Calgon Technical Department -- each group needed a liter sample to perform the indicated analyses. The sample frequency was set from two constraints: (1) the concentration levels from one hour to the next hour will not significantly vary since the influent water is well mixed*, and (2) the dewatering wells concentration levels change very little from one week to the next week. The first constraint indicates the concentration levels of contaminants will not build-up nor dilute over a period of time at any point except where the adsorption process is taking place or at the filter. The second constraint indicates the feed (influent) water contaminate levels to the Calgon Plant can be expected to remain fairly constant over long periods (months) of time. With these two constraints, well-mixed and pseudo-steady contaminates' levels, it was decided to take samples at the following frequencies:

Start-up Phase† = 15 samples and/or readings per day

(Stabilization) Pseudo-steady State = (1 month-6 months) 2 samples and/or readings per day

Steady State = (6 months - indefinitely) 1 sample and/or reading per day

NOTE: Adjustments in the number of samples and/or readings per day may have to be made if influent water to the Calgon Plant varies greater than previous history has indicated.

* - Due to turbulent flow and changes in pipe diameter & direction.

† - A certain amount of grab samples will be pulled during the plant start-up.

$\bar{X}$ AND R DATA SHEET AND CONTROL CHART

DIVISION	DATE	OPERATION	CHARACTERISTIC
C C	NOW	TEST	CLOUDY
SPEC. REQUIREMENT AND TOLERANCE		UNIT OF MEASURE	INSPECTOR
+/- 1		IN	QA MAN

$\bar{\bar{X}} = \frac{\Sigma \bar{X}}{H} =$ 2419.7

$\bar{R} = \frac{\Sigma R}{H} =$ 187.5

$UCL_{\bar{X}} = \bar{\bar{X}} + A_2\bar{R} =$ 2791.1

$LCL_{\bar{X}} = \bar{\bar{X}} - A_2\bar{R} =$ 2048.4

$UCL_R = D_4\bar{R} =$ 645.3

$LCL_R = D_3\bar{R} =$ 0.0

SAMPLE NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SAMPLE READINGS	X1	1548	1268	958	668	737	628	676	1148	1282	2229	1581	1656	2361	2917	2941	3198	2688	3885
	X2	1408	1118	888	783	693	681	668	1158	2857	885	1585	2413	3189	2540	3434	3865	2719	3878
	X3																		
	X4																		
	X5																		
	ΣX	2956	2378	1838	1843	1430	1309	1356	2307	3209	3114	3176	4069	5470	5586	6375	6263	5519	6875
AVG		1598,0	1185,0	915,0	921,5	715,0	654,5	679,0	1153,5	1604,5	1557,0	1586,0	2034,5	2735,0	2793,0	3187,5	3131,5	2758,5	3837,5
HIGH		1548	1268	958	668	737	681	668	1158	2857	2229	1591	2413	3189	2917	3434	3198	2688	3878
LOW		1408	1118	888	783	693	628	676	1149	1282	885	1585	1656	2361	2588	2941	3865	2719	3885
RANGE		88	158	78	77	44	53	2	9	865	1344	6	757	748	328	493	133	67	85